Introduction to Lighting

Chester A. Henson, P.E.

2012 Design Training Expo

Purpose of Roadway Lighting

The general purpose of roadway lighting is to provide improved visibility for the various users of the roadways and associated facilities.

Objectives of Lighting

- To supplement vehicle headlights, extending the visibility range beyond their limits both laterally and longitudinally.
- To improve the visibility of roadway features and objects on or near the roadway.
- To delineate the roadway ahead. To provide visibility of the environment.
- To reduce the apprehension of those using the roadway.

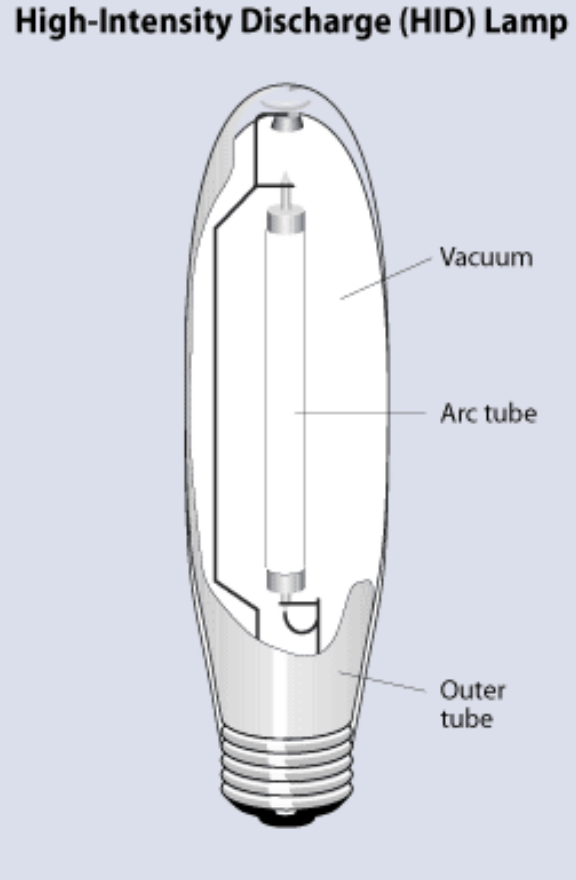
Types of Lighting

- High Mast Lighting
- Conventional Lighting
- Sign Lighting

Light Sources

- High Pressure Sodium
  - High Mast Lighting
  - Conventional Lighting
- Induction
  - Sign Lighting

High Pressure Sodium

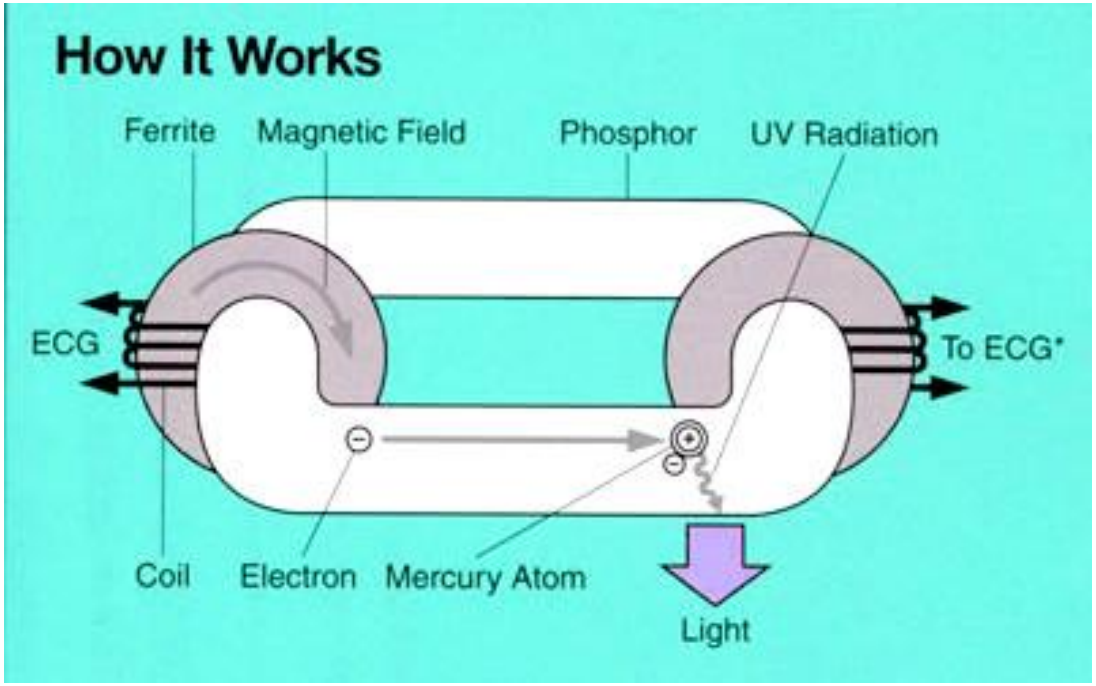


In a high-intensity discharge lamp, electricity arcs between two electrodes, creating an intensely bright light. Mercury, sodium, or metal halide gases act as the conductor.

High Pressure Sodium

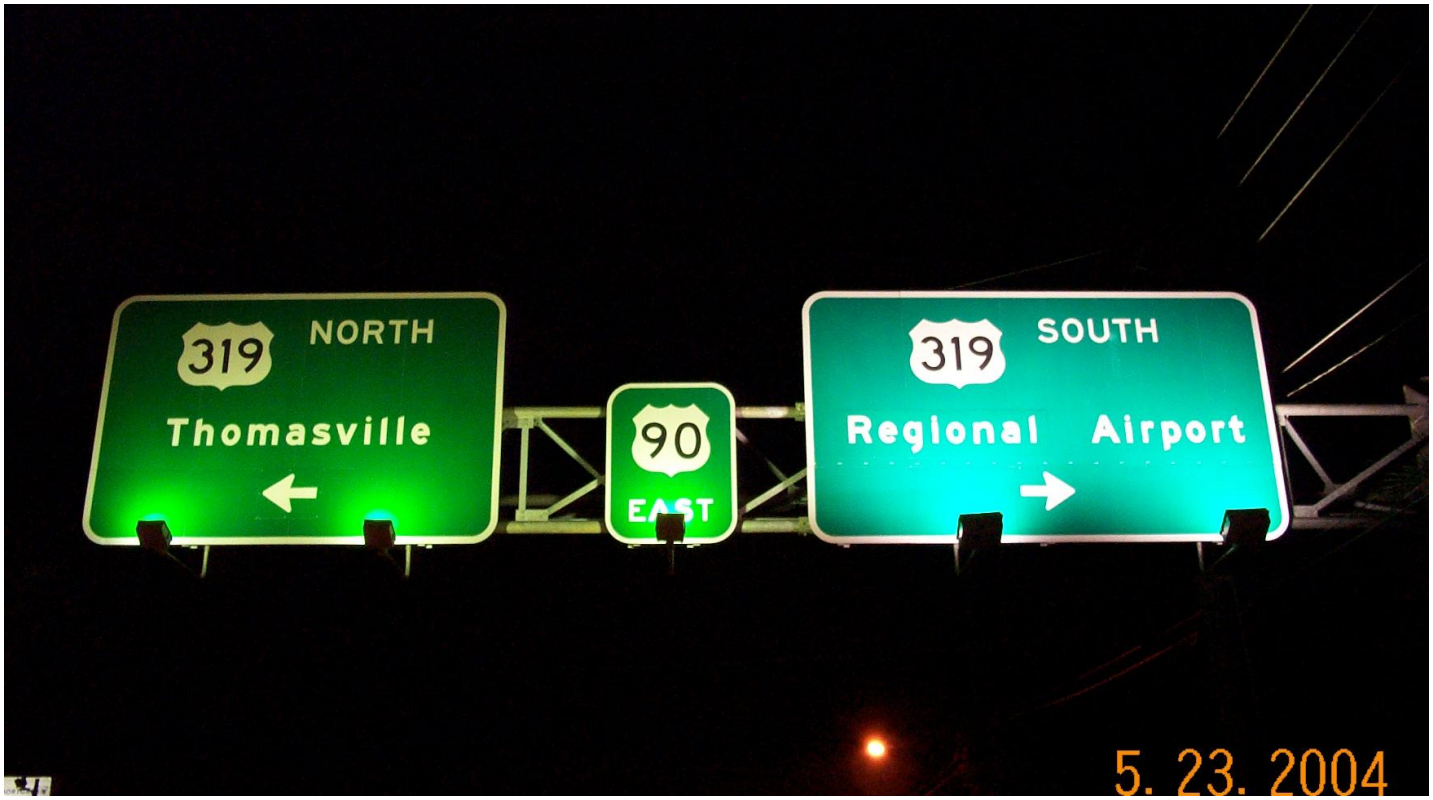
High Pressure Sodium

Induction

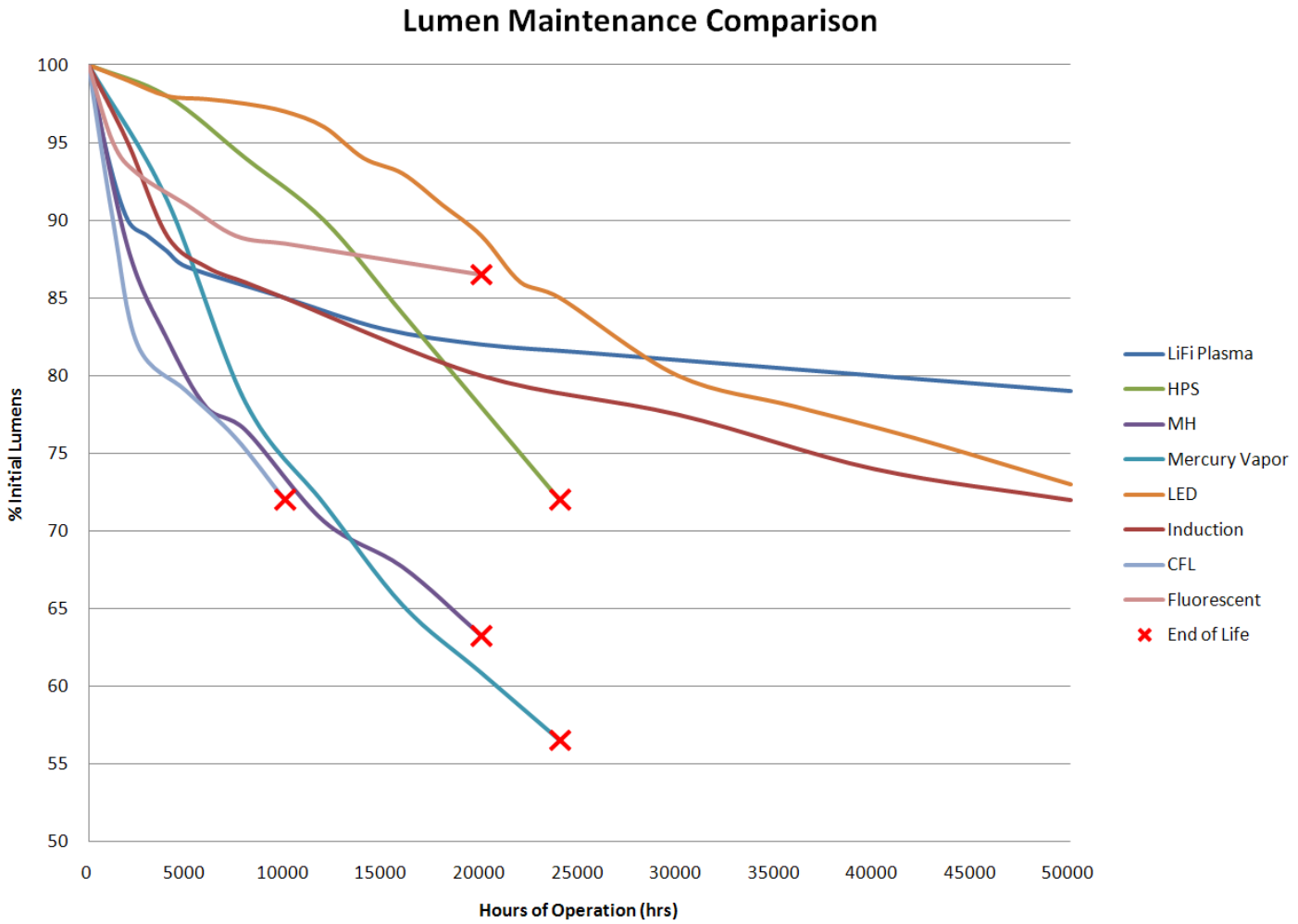


Electronic ballasts magnetically induce an electric field to create a current which circulates inside the lamp and excites the phosphorous to produce light in the same manner as standard fluorescent lamp.

Induction

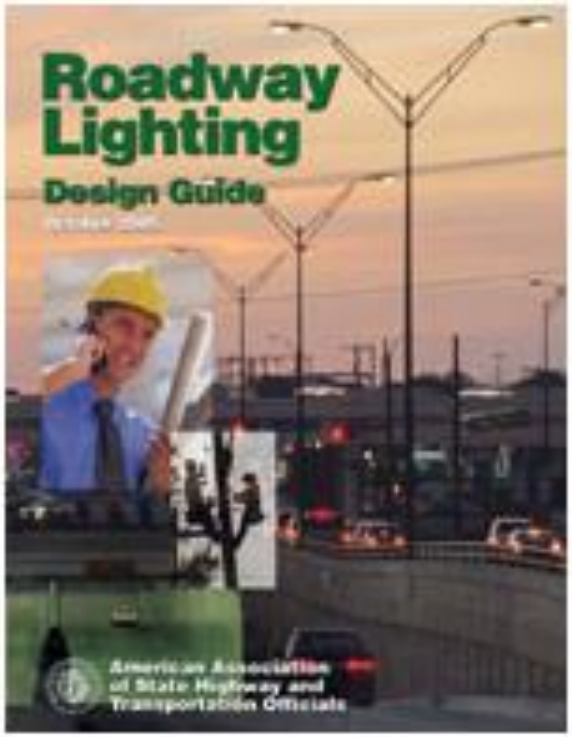

319
NORTH
Thomasville
90
EAST
319
SOUTH
Regional Airport
5. 23. 2004

Comparisons of Lumen Depreciation



Lighting Criteria

AASHTO Lighting Design Guide



Lighting Criteria

The criteria for highway lighting is in the Plans Preparation Manual, Volume I, Chapters 2 and 7.

Horizontal Clearance for poles is in Chapter 2

Lighting Design Criteria is in Chapter 7

Plans Preparation Manual Volume 1

- **2.11 Horizontal Clearance**

Table 2.11.2 Horizontal Clearance for Light Poles

CONVENTIONAL LIGHTING	Not in the median except in conjunction with barriers that are justified for other reasons. Rural and Urban Flush Shoulders: 20 ft. from the travel lane, 14 ft. from auxiliary lane (may be clear zone width when clear zone is less than 20 ft.). Urban Curb or Curb and Gutter: From right of way line to 4 ft. back of face of curb (may be 2.5 ft. back of face of curb when all other alternatives are deemed impractical). Placement within sidewalks shall be such that an unobstructed sidewalk width of 4 ft. or more (not including the width of curb) is provided.
HIGHMAST LIGHTING	Outside of the clear zone unless shielded.

Plans Preparation Manual Volume 1

- **7.3.1 Design Criteria**

  The ***AASHTO Roadway Lighting Design Guide*** permits either the illuminance technique or the luminance technique to be used in the design of highway lighting. The luminance technique requires a more complex design process and knowledge of the reflective characteristics of the pavement surface used. These reflective characteristics change as the pavement ages and with variations in weather conditions. The Department has elected to use the illuminance technique for lighting design. The design values for light levels given by the ***AASHTO Roadway Lighting Design Guide*** are maintained values. The light levels given in this criteria have been adjusted and are listed as average initial foot candle.

Plans Preparation Manual Volume 1

- **7.3.1 Design Criteria**

Table 7.3.1 Conventional Lighting - Roadways

ROADWAY CLASSIFICATIONS	ILLUMINATION LEVEL AVERAGE INITIAL HORIZONTAL FOOT CANDLE (H.F.C.)	UNIFORMITY RATIOS		VEILING LUMINANCE RATIO
		Lavg/Lmin	Lmax/Lmin	Lv(max)/Lavg
INTERSTATE, EXPRESSWAY, FREEWAY & MAJOR ARTERIALS	1.5	4:1 or Less	10:1 or Less	0.3:1 or Less
ALL OTHER ROADWAYS	1.0	4:1 or Less	10:1 or Less	0.3:1 or Less
* PEDESTRIAN WAYS AND BICYCLE LANES	2.5	4:1 or Less	10:1 or Less	------

Note: These values should be considered standard, but should be increased if necessary to maintain an acceptable uniformity ratio. The maximum value should be one and one-half values.

* This assumes a separate facility. Facilities adjacent to a vehicular roadway should use the levels for that roadway.

Plans Preparation Manual Volume 1

- **7.3.1 Design Criteria**

Table 7.3.2 Highmast Lighting - Roadways

ROADWAY CLASSIFICATIONS	ILLUMINATION LEVEL AVERAGE INITIAL (H.F.C.)	UNIFORMITY RATIOS	
		AVG./MIN.	MAX./MIN.
INTERSTATE, EXPRESSWAY, FREEWAY & MAJOR ARTERIALS	0.8 to 1.0	3:1 or Less	10:1 or Less
ALL OTHER ROADWAYS	0.8 to 1.0	3:1 or Less	10:1 or Less

Table 7.3.3 Sign Lighting

AMBIENT LUMINANCE	ILLUMINATION LEVEL AVERAGE INITIAL (H.F.C.)	UNIFORMITY RATIOS
		MAX./MIN.
LOW	15 - 20	6:1
MEDIUM & HIGH	25 - 35	6:1

Conventional Lighting

Conventional Lighting

Conventional Lighting

Conventional Lighting

Conventional Lighting

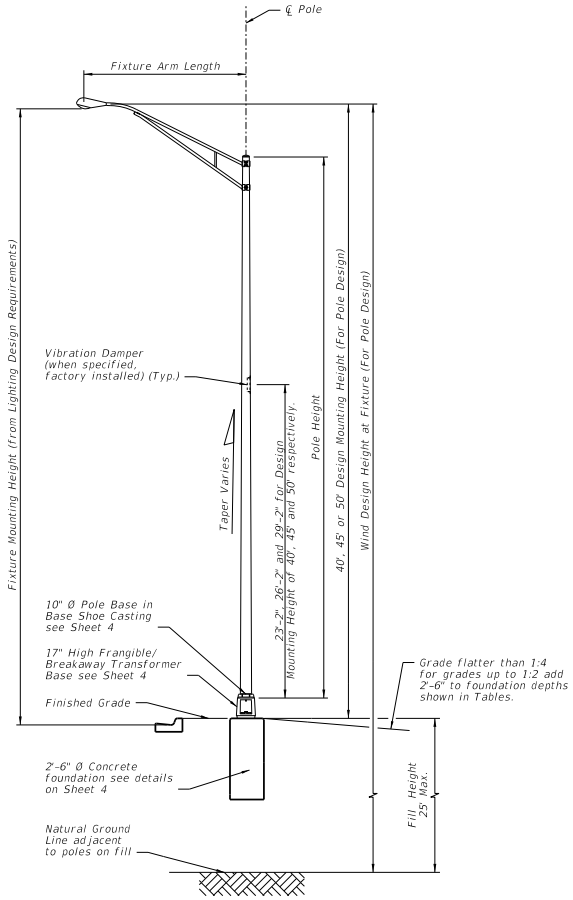
Conventional Lighting

Conventional Lighting

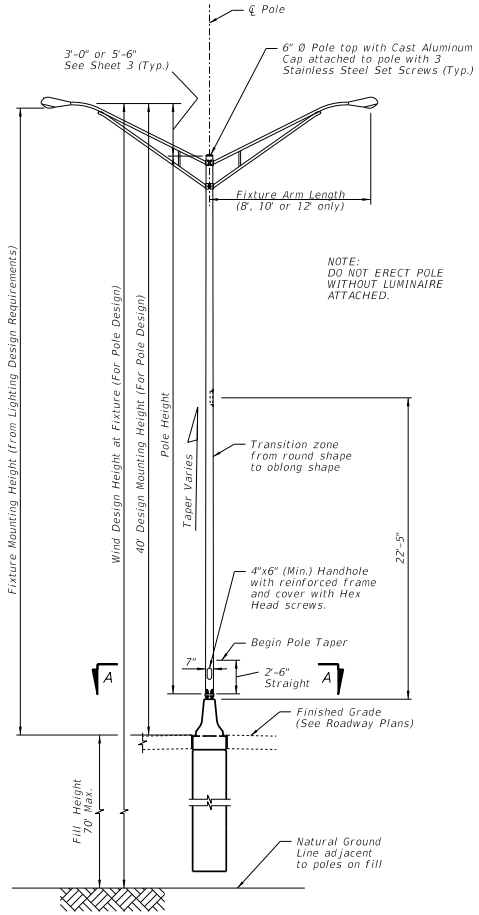
- **Design Variables**
  - Pole Spacing & Location

Conventional Lighting

Pole Spacing and Location



STANDARD ROADWAY ALUMINUM LIGHT POLE



MEDIAN BARRIER MOUNTED ALUMINUM LIGHT POLE ON CYLINDRICAL FOUNDATION

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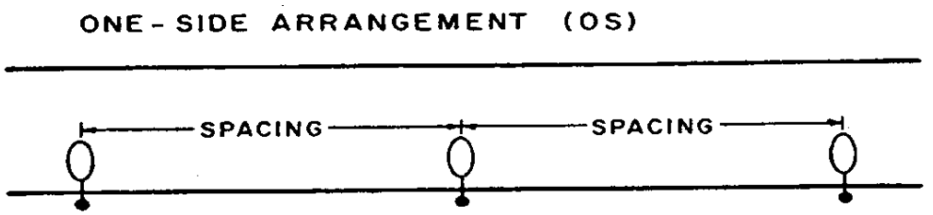
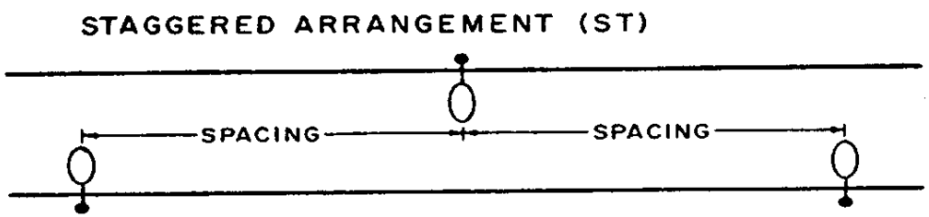
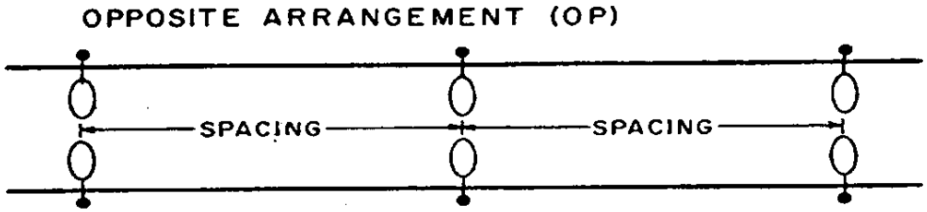
Conventional Lighting

Pole Spacing and Location





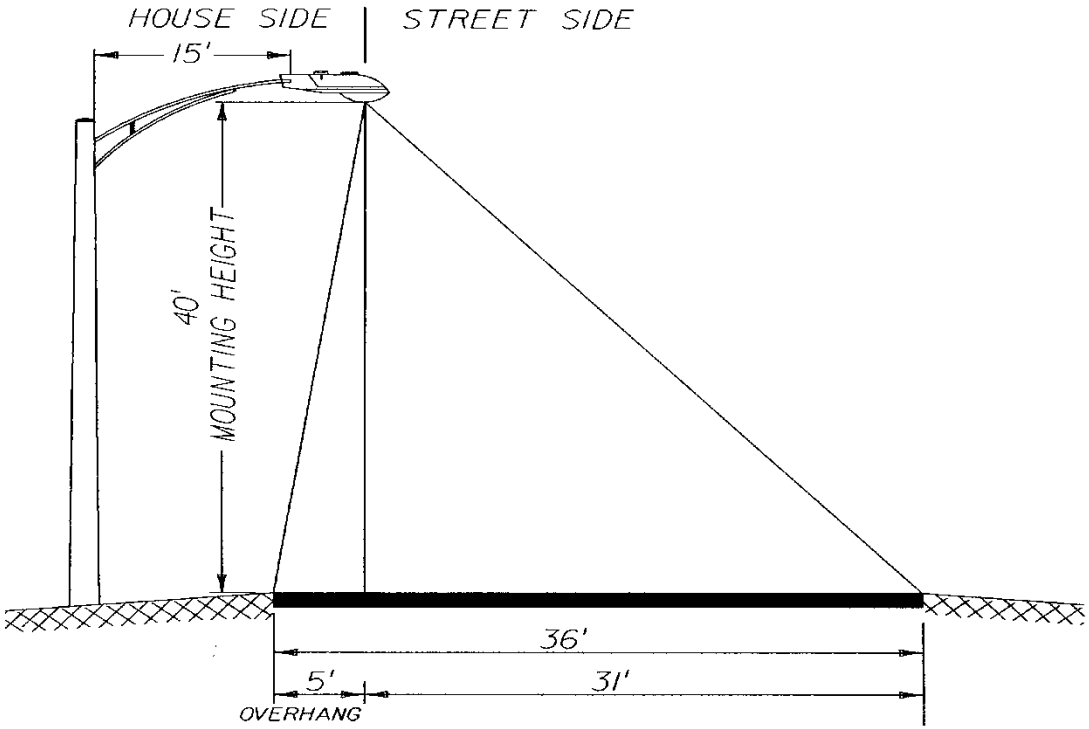


Conventional Lighting

- **Design Variables**
  - Pole Spacing & Location
  - Pole Mounting Height

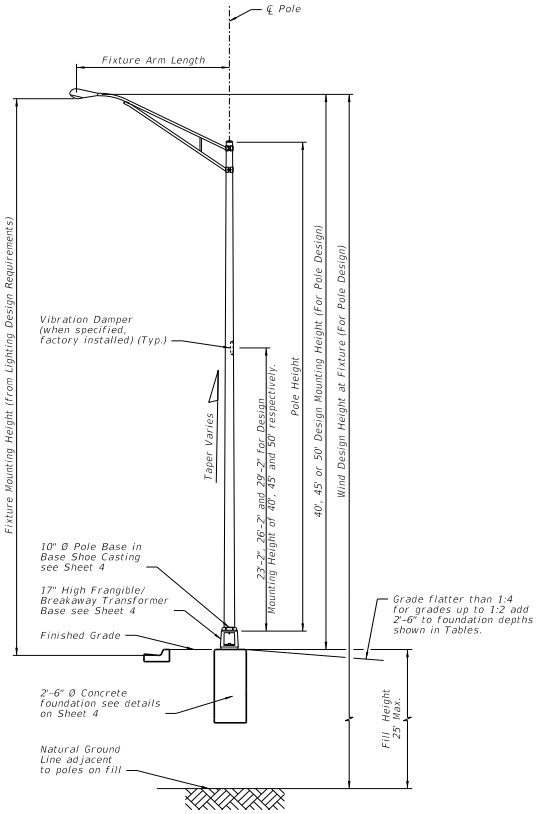
Conventional Lighting

Mounting Height



Conventional Lighting

Mounting Height

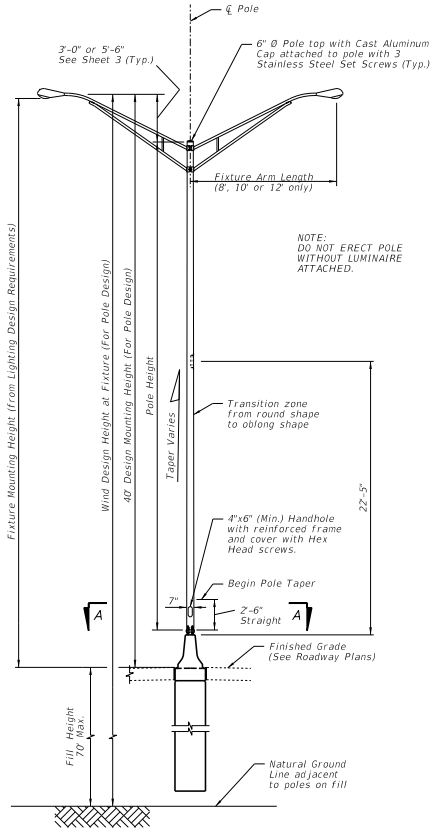


STANDARD ROADWAY
ALUMINUM LIGHT POLE

POLE TABLE					
WIND SPEED (MPH)	ARM LENGTH (FT)	DESIGN MOUNTING HEIGHT (FT)	POLE WALL (IN)	UPPER WELD (IN)	LOWER WELD (IN)
110	8, 10, 12 & 15	40 & 45	0.156	0.156	0.156
110	8, 10, 12 & 15	50	0.188	0.188	0.188
130	8, 10 & 12	40	0.156	0.156	0.156
130	15	40	0.188	0.188	0.188
130	8, 10, & 12	45	0.188	0.188	0.188
130	15	45	0.250	0.250	0.250
130	8, 10, 12 & 15	50	0.250	0.250	0.250
150	8, 10, & 12	40	0.188	0.188	0.188
150	15	40	0.250	0.250	0.250
150	8, 10, 12 & 15	45	0.250	0.250	0.250
150	8, 10, 12 & 15	50	0.313	0.313	0.313

Conventional Lighting

Mounting Height



MEDIAN BARRIER MOUNTED ALUMINUM LIGHT POLE ON CYLINDRICAL FOUNDATION

POLE TABLE				
WIND SPEED (MPH)	ARM LENGTH (FT)	DESIGN MOUNTING HEIGHT (FT)	POLE WALL (IN)	FILL HEIGHT (FT)
110	8, 10, 12	40	0.25	Up to 70'
130	8, 10, 12	40	0.25	Up to 70'
150	8, 10, 12	40	0.25	Up to 20'
150	8, 10, 12	40	0.313	>20' to 70'

Conventional Lighting

- **Design Variables**
  - Pole Spacing & Location
  - Pole Mounting Height
  - Arm Length

Conventional Lighting

Arm Length

POLE TABLE				
WIND SPEED (MPH)	ARM LENGTH (FT)	DESIGN MOUNTING HEIGHT (FT)	POLE WALL (IN)	FILL HEIGHT (FT)
110	8, 10, 12	40	0.25	Up to 70'
130	8, 10, 12	40	0.25	Up to 70'
150	8, 10, 12	40	0.25	Up to 20'
150	8, 10, 12	40	0.313	>20' to 70'

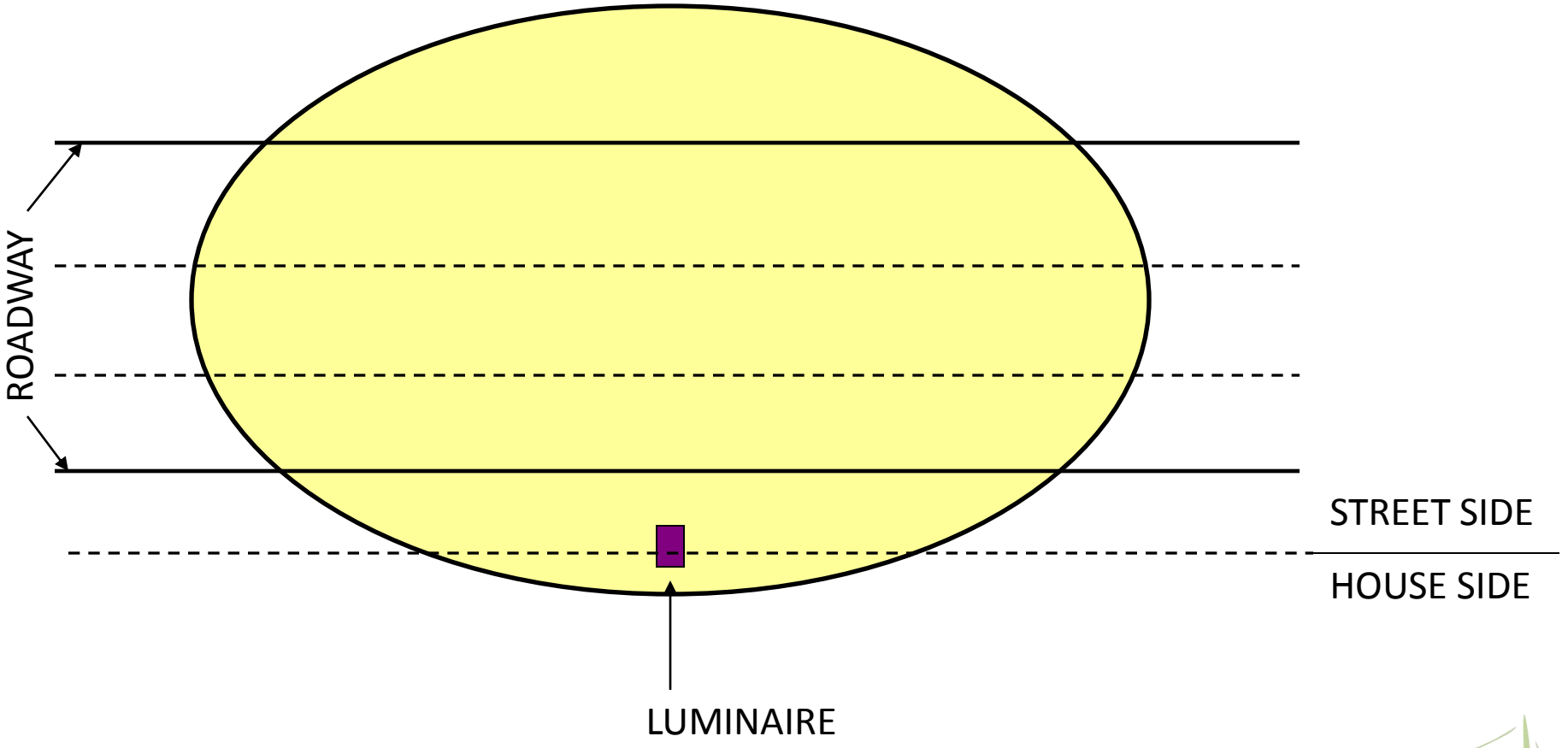
POLE TABLE					
WIND SPEED (MPH)	ARM LENGTH (FT)	DESIGN MOUNTING HEIGHT (FT)	POLE WALL (IN)	UPPER WELD (IN)	LOWER WELD (IN)
110	8, 10, 12 & 15	40 & 45	0.156	0.156	0.156
110	8, 10, 12 & 15	50	0.188	0.188	0.188
130	8, 10 & 12	40	0.156	0.156	0.156
130	15	40	0.188	0.188	0.188
130	8, 10, & 12	45	0.188	0.188	0.188
130	15	45	0.250	0.250	0.250
130	8, 10, 12 & 15	50	0.250	0.250	0.250
150	8, 10, & 12	40	0.188	0.188	0.188
150	15	40	0.250	0.250	0.250
150	8, 10, 12 & 15	45	0.250	0.250	0.250
150	8, 10, 12 & 15	50	0.313	0.313	0.313

Conventional Lighting

- **Design Variables**
  - Pole Spacing & Location
  - Pole Mounting Height
  - Arm Length
  - Luminaire Distribution Pattern

Conventional Lighting

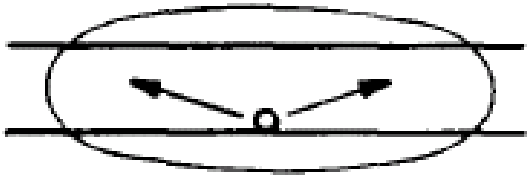
Luminare Distribution Pattern



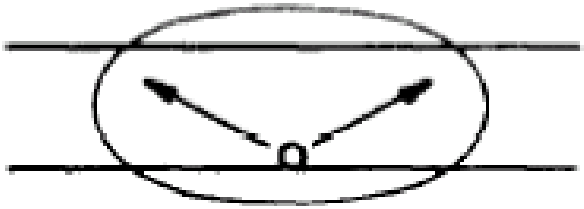
Conventional Lighting

Luminare Distribution Pattern

Type II



Type III



Type IV

Conventional Lighting

- **Design Variables**
  - Pole Spacing & Location
  - Pole Mounting Height
  - Arm Length
  - Luminaire Distribution Pattern
  - Luminaire Selection

Conventional Lighting

Luminaire Selection

Bulb	Base	LET	OP	Watts	MOL	LCL	Order Code	Description	ANSI Ballast Type	Case Qty.	CBCP	Rated Life (hours)	Lumens Initial	Lumens Mean	Color Temp. K	CRI	Additional Information
250 WATTS																	
ED18	Mog	O	U	250	9.75	5.75	44047	LU250	S50	12		24000+	28000	27000	2100	22	Clear
							26430	LU250/CP	S50	4		24000+	28000	27000	2100	22	Clear, Consumer Pack
ED28	Mog	O	U	250	9	5	44051	LU250/D	S50	12		24000+	26000	23400	2100	22	Diffuse
310 WATTS																	
ED18	Mog	O	U	310	9	5.75	44053	LU310	S67	12		24000+	37000	33300	2100	22	Clear
400 WATTS																	
ED18	Mog	O	U	400	9	5.75	44054	LU400	S51	12		24000+	51000	45000	2100	22	Clear
					9.75	5.75	26431	LU400/CP	S51	4		24000+	51000	45000	2100	22	Clear, Consumer Pack
ED37	Mog	O	U	400	11.31	7	44056	LU400/D	S51	6		24000+	47500	42750	2100	22	Diffuse
T7	Rx7s	O	HOR	400	10.12		30244	LU400/TD	S51	10		24000	43000	37300	2000	25	Clear, Double-ended, Horizontal Burn ±20°
600 WATTS																	
T15	Mog	O	U	600	11.06	6.62	27187	LU600/T	S106	12		12000+	90000	81000	2000	22	Clear
750 WATTS																	
ED37	Mog	O	U	750	11.5	6.75	14682	LU750	S111	6		24000+	110000	99000	2100	22	Clear
1000 WATTS																	
E25	Mog	O	U	1000	15.06	8.75	44058	LU1000/ECO	S52	6		24000+	140000	126000	2100	22	Clear
T7	Rx7s	O	HOR	1000	13.18		30246	LU1000/TD	S52	10		24000	137500	118200	2000	25	Clear, Double-ended, Horizontal Burn ±20°

High Mast Lighting

- **Design Variables**
  - Pole Spacing & Location
  - Pole Mounting Height
  - ~~Arm Length~~
  - Luminaire Selection
  - Luminaire Distribution Pattern
  - Number of Fixtures

High Mast Lighting

Pole Spacing and Location

High Mast Lighting

Pole Mounting Height

Pole Design Table*															
Design Wind Speed	Pole Overall Height (ft)	Section 1 (Top)					Section 2					Section 3				
		Length	Wall Th.	Minimum Splice L.	Tip Dia.	Base Dia.	Length	Wall Th.	Minimum Splice L.	Tip Dia.	Base Dia.	Length	Wall Th.	Minimum Splice L.	Tip Dia.	Base Dia.
110 mph	80	42'-0"	0.250"	2'-0"	5.313"	11.219"	40'-0"	0.250"	---	10.375"	16.000"	---	---	---	---	---
	100	24'-6"	0.179"	2'-0"	6.406"	9.844"	40'-0"	0.250"	2'-6"	9.188"	14.781"	40'-0"	0.250"	---	13.875"	19.500"
	120	44'-9"	0.250"	2'-0"	6.250"	12.531"	40'-0"	0.250"	2'-9"	11.688"	17.313"	40'-0"	0.313"	---	16.375"	22.000"
130 mph	80	42'-0"	0.250"	2'-0"	5.281"	11.188"	40'-0"	0.313"	---	10.375"	16.000"	---	---	---	---	---
	100	24'-6"	0.179"	2'-0"	6.906"	10.344"	40'-0"	0.250"	2'-6"	9.656"	15.281"	40'-0"	0.313"	---	14.375"	20.000"
	120	45'-6"	0.250"	2'-6"	9.250"	15.625"	40'-0"	0.250"	3'-0"	14.719"	20.344"	40'-0"	0.313"	---	19.375"	25.000"
150 mph	80	42'-3"	0.250"	2'-3"	7.281"	13.219"	40'-0"	0.313"	---	12.375"	18.000"	---	---	---	---	---
	100	24'-6"	0.250"	2'-0"	8.188"	11.625"	40'-0"	0.313"	2'-6"	10.781"	16.406"	40'-0"	0.375"	---	15.375"	21.000"
	120	46'-6"	0.250"	3'-0"	12.406"	18.938"	40'-0"	0.313"	3'-6"	17.938"	23.563"	40'-0"	0.375"	---	22.375"	28.000"

* Diameter Measured Flat to Flat

Sign Lighting

- **Design Variables**
  - Luminaire Selection
  - Luminaire Distribution Pattern

Sign Lighting

Luminaire Selection

- H.E. Williams
- Holophane
- General Electric

Lighting Programs

- AGI 32 (Department Uses)
- Visual
- Alladin (GE)
- CALA (Holophane)

Lighting Programs

Luminaire Selection

- H.E. Williams
- Holophane
- General Electric